

Serial No.: 10/660,471
Confirmation No.: 4947
Applicant: PALMBERG *et al.*
Atty. Ref.: 06730.0056.NPUS00

AMENDMENTS TO THE SPECIFICATION:

Please amend the specification by replacing paragraphs 32, 41, 43, 44, 45, 47, 57 and 59 as follows

[0032] Referring to Fig. 1, a Hydraulic Power Assisted Steering system 100 (hereinafter denoted HPAS-system) is illustrated. The HPAS-system 100 is preferably a system for use for steering the road wheels of an automobile or a vehicle, which system 100 is equipped with a rotary valve ~~440~~ 130 according to the present invention. Although the HPAS-system 100 is described in connection with a hydraulic power assisted steering of road wheels of an automobile, it should be appreciated that the HPAS-system 100 according to the present invention may be employed to steer any number of front and/or rear wheels or other propulsion equipment of a steered vehicle.

[0041] The rotary valve 300 illustrated in fig. 2 comprises a first cylindrical valve member 305 and a second cylindrical valve member 310, adapted to regulate the flow of a hydraulic fluid such as oil or similar. The first ~~second~~ cylindrical valve member 305 ~~340~~ may in a preferred embodiment constitute a part of the valve house. The second ~~first~~ cylindrical valve member 310 ~~305~~ is drive or press fitted on the steering shaft 121 and consequently arranged to rotate together with the steering shaft 121, whereas the first ~~second~~ valve member 305 ~~340~~ is rotatably or turnable connected to the pinion shaft 210, such that the first ~~second~~ valve member 305 ~~340~~ may rotate together with the pinion shaft 122 at an offset angle α_{off} with respect to the pinion shaft 122.

[0043] The extension of the pinion shaft 122 comprising the rotary valve 300 in fig. 2 has an inlet through-hole 315 for receiving a pressurized hydraulic fluid from the servo pump 128, and a first chamber 320 communicating with two first outer through-holes 325 arranged in the first ~~second~~ cylindrical valve member 305 ~~340~~, where the first outer through-holes 325 are adapted to dynamically communicate with a corresponding pair of first inner through-holes 330 arranged in the second ~~first~~ cylindrical valve member 310 ~~305~~, where the first inner through-holes 330

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communicate with a second chamber 335 arranged inside the second ~~first~~ cylindrical valve member 305.

[0044] Said second chamber 335 communicates with a second pair of inner through-holes 340 arranged in the second ~~first~~ cylindrical valve member 310 ~~305~~, where the second pair of inner through-holes 330 are adapted to dynamically communicate with a second pair of outer through-holes 345 arranged in the first ~~second~~ cylindrical valve member 305 ~~310~~, where the second outer through-holes 345 communicate with a third chamber 350, which in turn communicates with an outlet through-hole 360 for an outlet of the received pressurized hydraulic fluid, where both the third chamber 350 and the outlet through-hole 360 are arranged in the extension of the pinion shaft 122 for supplying pressurized hydraulic fluid to the servo-motor 129.

[0045] The first cylindrical valve member 305 and the second cylindrical valve member 310 of the rotary valve 300 are further illustrated in fig. 3, showing a perspective view of the members 305, 310, where the member 310 ~~305~~ has been lifted from the member 305 ~~310~~. The members 305, 310 are illustrated with the through-holes 330, 340 of member 310 ~~305~~ in a position where they partly coincide with the through-holes 325, 345 of member 305 ~~310~~, if the two members 305, 310 had been put together in an operative position, i.e. if the members 305, 310 had been operatively arranged in a rotary valve 300 as shown in fig. 2. Such an operative position of the through-holes 330, 340, 325, 345 indicates that there is an angular difference α_A between the turning angle α_{sw} of the steering wheel and the turning angle α_{ps} of the pinion shaft, e.g. caused by a driver turning the steering wheel 120. When the through-holes 330, 340 in an operative position coincide with the through-holes 325, 345 a flow of pressurized hydraulic fluid passes from the servo-pump 128 through the rotary valve 300 and to the servo-motor 129 as described above, whereupon the servo-motor 129 may deliver an assist force F_{ass} to reduce the steering effort required by the driver in changing the direction of the road wheels 127.

[0047] The rotary valve 300 may also comprise a flange portion 370 formed as a protrusion of the first cylindrical valve member 305 and arranged at the lower end of said member 305. The

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flange portion 370 protrudes into a recess chamber 371 arranged in the extended portion of the pinion shaft 122, as can be seen in fig. 2. The flange portion 370 and the recess chamber 371 are further illustrated in fig. 4, showing a cross section of the interconnection assembly 130 cut through the line A-A in fig. 2. As can be seen in fig. 4 the recess chamber has a first inlet-outlet port 372 arranged to the right and a second inlet-outlet port 373 arranged to the left, arranged to receive and expel hydraulic fluid. The flange portion 370 is arranged to rotate an offset angle $\pm \alpha_{\text{off}}$ together with the first cylindrical valve member 305, as illustrated by the two opposite arrows in fig. 4. The maximum rotation angle α_{max} in this embodiment is determined by the size of the recess chamber 317, extending as a cut ring-shaped circle-segment along the wall of the pinion shaft 122. It is further preferred that the flange portion 370 is tightly arranged towards a wall portion 374 of the recess chamber 371, formed by the outer wall periphery of the pinion shaft 122, so as to cut the recess chamber 371 into a left and a right hydraulic chamber. In this way the first cylindrical valve member 305 may be rotated clockwise a small offset angle α_{off} by increasing the hydraulic pressure in the right hydraulic chamber and decreasing the hydraulic pressure in the left chamber, whereas the first cylindrical valve member 305 may be rotated counter clockwise a small offset angle α_{off} by increasing the hydraulic pressure in the left hydraulic chamber and ~~decreasing~~ ~~increasing~~ the hydraulic pressure in the right chamber. Hence, once a certain hydraulic pressure has been established in said chambers the first cylindrical valve member 305 will rotate together with the pinion shaft 122, however possibly displaced by a small angle α_{off} with respect to the pinion shaft.

[0057] This may be accomplished by non-rotatably attaching the first cylindrical valve member 305 to a valve house 520 that i.a. encases the first and second cylindrical valve members 305, 310 as shown in fig. 7. The valve house 520 may somewhat be similar to the extension of the pinion shaft 122 shown in fig. 2, which i.a. encases the first and second cylindrical valve members 305, 310. However, the valve house 520 is arranged so that it may freely rotate a small offset angle α_{off} with respect to the pinion shaft 122. This is illustrated in fig. 7 by the small

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empty space ~~525~~ ~~520~~ that cylindrically surrounds the top of the pinion shaft 122 and which consequently separates the lower end of the valve house 520 from the pinion shaft 122.

[0059] The rotational movement of the valve house 520 is then preferably obtained by a diagonal track or slot 510, e.g. arranged as a cylindrical flange portion 515 that is arranged to extend axially downward from the lower part of the valve house 520, where the slot 510 is guided by a rivet 511 or some other suitable guiding device that is arranged on the pinion shaft 122. Hence, when the valve house 520 and the cylindrical flange 515 firmly attached thereto are move up or down by a slight rotation of the eccentric axis 505 that is actuated by the motor 500 this will cause the valve house 520 to rotate as the diagonal slot 510 moves guided by the rivet 511. The valve house 520 and the cylindrical flange ~~515~~ ~~525~~ may be dynamically moved up and down by the eccentric axis 505 actuated by the electric motor 500 so that the diagonal slot 510 may take any position between position A and position B, as indicated in fig. 8.